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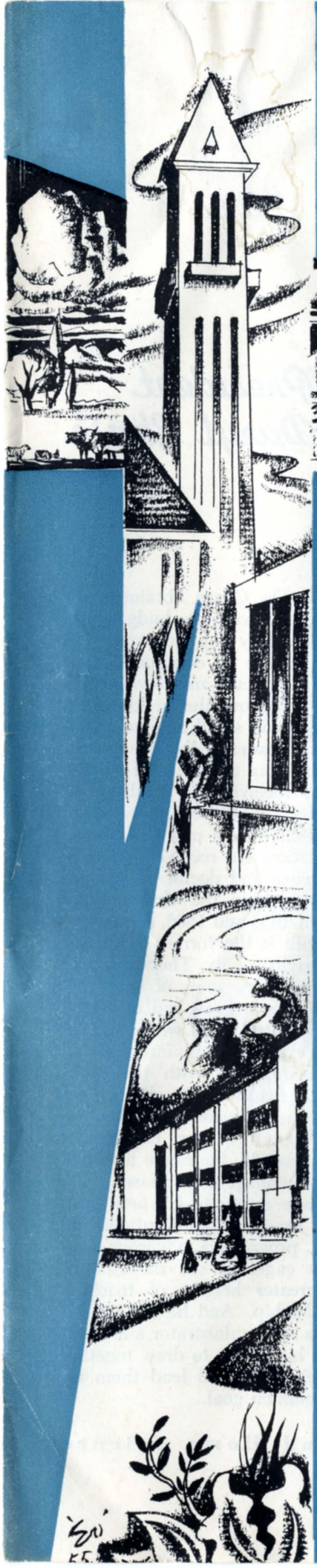
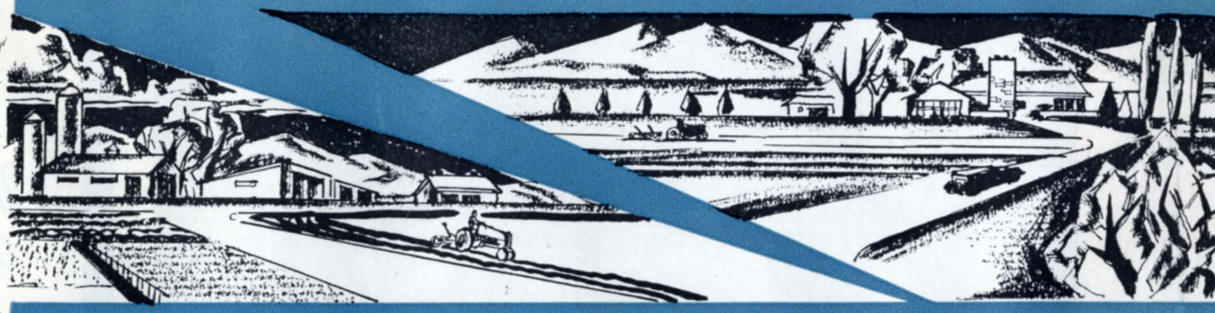


Farm and Home Science



AGRICULTURAL EXPERIMENT STATION
UTAH STATE AGRICULTURAL COLLEGE

Vol. 16 No. 1 March 1955

In This Issue

President Daryl Chase

DR. DARYL CHASE became tenth president of the Utah State Agricultural College, December 3, 1954. Dr. Chase replaces Dr. Henry Aldous Dixon who was elected to represent the first Utah district in the United States Congress.

Dr. Chase returned to the college as new president after three years as director of the College of Southern Utah. From 1945 to 1951 he served as dean of students at USAC. Before that time he had been director of LDS institutes at Idaho State College, University of Wyoming, University of Arizona, and USAC.

During his six years at Utah State he was instrumental in converting student dreams of a union building into concrete action. He was faculty adviser for the temporary student union, known as the TUB, and it was under his effort and guidance that the present union building was planned and built. As dean of students he reorganized the student personnel office. He earned the reputation as a friend of the students. He was also active in public relations, establishing campus housing units, and in procuring war surplus equipment.

At CSU Dr. Chase obtained new buildings, a favorable budget, unusual community support, and a 22 percent increase in enrollment. The love of the students and townspeople of Cedar City and the buildings on the campus will stand as monuments to him as a leader of that institution.

Dr. Chase is a native of Nephi, Utah. He received his bachelor of science degree at the University of Utah in 1927 with a major in history and education. He received his master of science and doctor of philosophy degrees from the University of Chicago in 1933 and 1936, respectively. His wife is the former Alice Koford of Brigham City. They have one son, Peter, twelve years of age.

Dr. Chase was born and raised on a farm in central Utah where he had practical experience in farming and became acquainted with the problems of agriculture. As director of CSU he was associated with the research program of the Experiment Station, especially the range livestock and range management phases.

Dr. Chase comes to his new position with excellent qualifications. He is young, progressive, vigorous, and genuinely eager to see the College rise to greater heights of teaching and scholarship. And he has proved himself as an administrator and demonstrated his ability to draw together divided elements and lead them toward a common goal.

The Future of Agriculture in Utah is Closely Tied to The Development of Water

W. PRESTON THOMAS

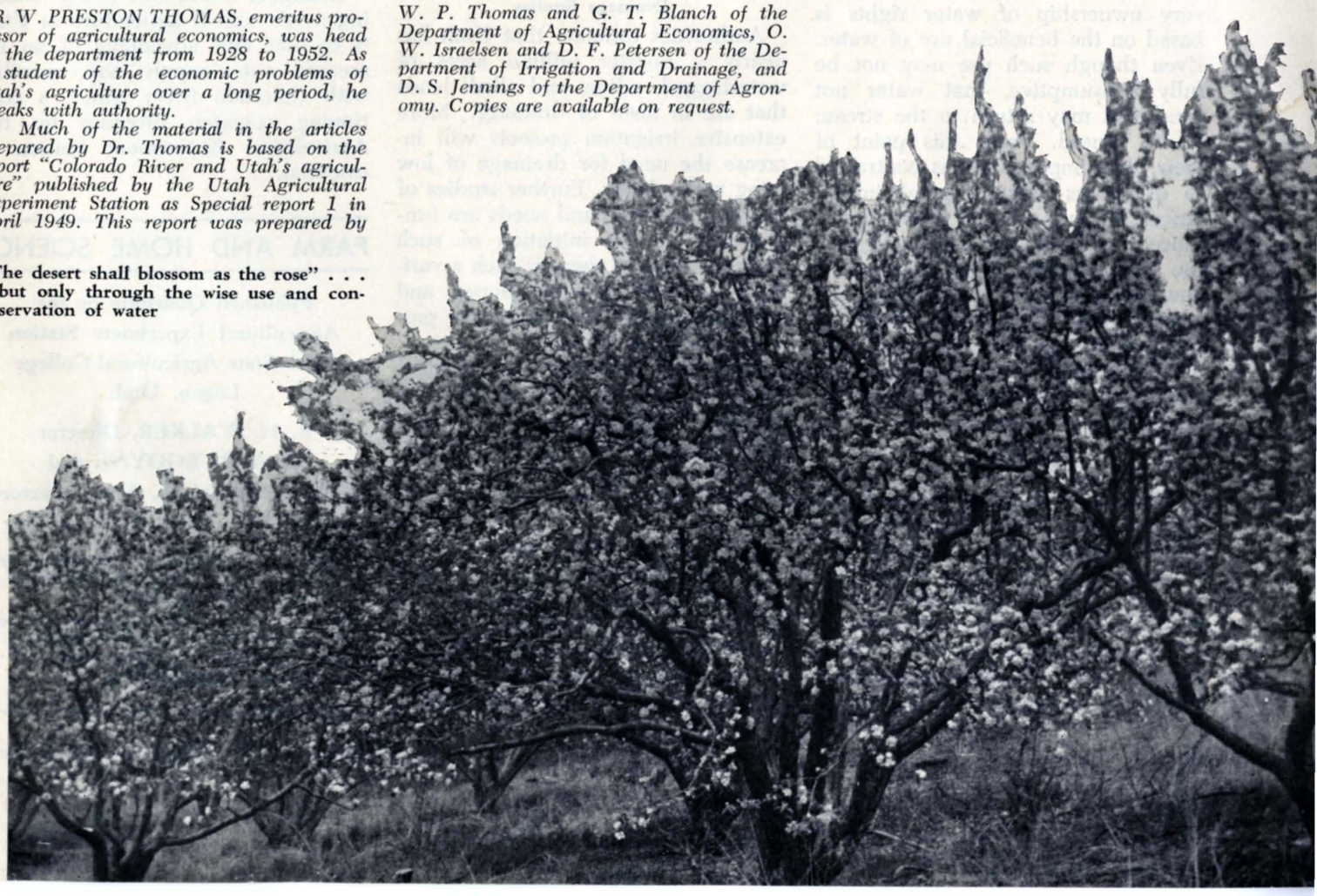
UTAH'S hope for agricultural expansion and development and the addition of new agricultural wealth lies in the further development and more efficient use of irrigation water within the state, and in transfer of irrigation water from the Colorado River Basin to the Bonneville Basin. Further development of irrigation water within the state and the transfer of Utah's share of the Colorado River water to the Bonneville Basin would provide water for a half million acres of new land and a supplemental supply to another half million acres or a total of a million acres to be benefited. Crop production would be increased 70 percent and Utah's agriculture would be stabilized through utilization of the state's water resources. The following is a summary of what the proposed irrigation development means to Utah:

WHAT THE PROPOSED IRRIGATION DEVELOPMENT MEANS TO UTAH

Arable land suitable for crop production in Utah is	3,176,000 acres
Land now irrigated	1,165,100 acres
Dry farmed lands	517,000 acres
Total cropped land	1,682,100 acres
Land with adequate water supply	408,000 acres
Land with a partial supply	759,000 acres
Portion of irrigated land with adequate supply	40 percent
Portion of irrigated land with partial supply	60 percent
Portion of irrigated land with adequate supply after development of water resources	90 percent
New land to be irrigated after development	607,000 acres
Total land now irrigated and new lands	1,772,100 acres
Increase in land with adequate supply after development	125 percent
Water needed annually to irrigate adequately all arable lands	10,142,000 acre feet
Water now available annually for irrigation	2,875,000 acre feet
Water annually available if water resources were developed	5,039,000 acre feet
Adequacy of present water supply for all arable land	28 percent
Adequacy of water supply after development for all arable lands	50 percent
Increase in crops production after development	70 percent
Increase in cash farm income after development	60 percent
Increase in number of farms	12 percent
Increase in farm population	28 percent

DR. W. PRESTON THOMAS, emeritus professor of agricultural economics, was head of the department from 1928 to 1952. As a student of the economic problems of Utah's agriculture over a long period, he speaks with authority.

Much of the material in the articles prepared by Dr. Thomas is based on the report "Colorado River and Utah's agriculture" published by the Utah Agricultural Experiment Station as Special report 1 in April 1949. This report was prepared by W. P. Thomas and G. T. Blanch of the Department of Agricultural Economics, O. W. Israelsen and D. F. Petersen of the Department of Irrigation and Drainage, and D. S. Jennings of the Department of Agronomy. Copies are available on request.



"The desert shall blossom as the rose" . . . but only through the wise use and conservation of water

Wise Use of New Water Will Need Sound Planning and Basic Research

THE Utah Agricultural Experiment Station is wholeheartedly behind the Upper Colorado River Project now under consideration by Congress. The future expansion of both agriculture and industry in Utah depends on the development of additional water supplies, and the only major source of new water is from the Colorado River.

The wise use of the water, power, and land resources brought into use under the Colorado River Project will depend to a large extent on sound planning and basic research. For agriculture, this is one of the principal functions of the Experiment Station. It has the scientists trained in the areas where fundamental information is needed.

Consumptive Use Studies

The Station has already cooperated in making extensive consumptive water use studies in the Ashley Valley and Emery areas. Station engineers are now working with other agencies in the Milford area. One of the major obstacles to the efficient and economical planning and administration of irrigation water supplies in the past has been the lack of detailed and reliable information concerning the quantity of water actually consumed by crops and by other land uses under varying climatic conditions. In the Western States the very ownership of water rights is based on the beneficial use of water. Even though such use may not be fully consumptive, that water not consumed may return to the stream to be reused. From this point of view, consumptive use as contrasted to diversions assumes great importance. Because of the great importance of water to the development of the Intermountain West, planners of new projects must now predict accurately the hydrologic effect of every proposed diversion and use. Thus the need for consumptive use studies in order that accurate determinations can be made.

Soil Surveys

For the water to be used in the areas where it will produce the greatest benefits, the soils must be surveyed to determine their characteristics and arability. Large areas of the state have not yet been surveyed. If efficient use is to be made of the land specific and detailed information about the character and quality of soils is necessary. No permanent system of agriculture can be built up, land values established, or equitable taxation schedules outlined until the status of the land is determined. The soil survey is also the basis of reliable recommendations of land use and fertilizer practices.

Farm Management Studies

In addition to surveying the soil, farm management studies must be made to determine the ability of the farms to pay for the costs of new water developments and the time period required for payments.

Drainage Studies

Authorities estimate that Utah has nearly a quarter million acres of waterlogged, saline, and alkali lands that are in need of drainage. More extensive irrigation projects will increase the need for drainage of low lying valley lands. Further studies of drainage methods and needs are fundamental to the initiation of such projects, because there is such a variation in soil formation, slopes, and artesian pressure that each area presents special problems.

After the land has been drained there is need for better methods of bringing it back into productivity and for crops that are salt tolerant that can be grown during the process of bringing the land back into full productivity.

Water Conservation

Water and power will bring further industrial growth with increased demands for more water both by the industries themselves and by the added population accompanying this industrial expansion. Studies of means of water conservation by both agriculture and industry will become more pressing. Ways must be found to lessen the loss of water through canal and reservoir seepage and to increase the efficiency of irrigation.

More water and more people will change the pattern of Utah's agriculture. There will be a demand for more truck crops, more fresh fruits and vegetables, more fluid milk, eggs, and broilers. Water will make this type of intensive farming profitable on the small farms of the state. But more intensive farming increases the problems of soil fertility, of plant diseases and insect pests. Research is necessary to solve these problems.

As industries expand other problems will arise. Only through an active research program can problems be diagnosed and information obtained whereby the successful and profitable coexistence of industry and agriculture is possible.

Changing conditions bring changing needs, and if agriculture in Utah is to take full advantage of an increased water supply made possible with Colorado River water, a continuing research program by the Agricultural Experiment Station is essential.

FARM AND HOME SCIENCE

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GLADYS L. HARRISON, Editor

Address correspondence regarding material appearing in these columns either to the editor or to the author.

More detailed information on the subjects discussed here can often be found in Station bulletins and circulars or may be had through correspondence.

Early Settlement and Irrigation Went Hand in Hand

W. PRESTON THOMAS

UTAH is an arid region. Irrigation was born of necessity, and Utah settlers were forced to be pioneers in irrigation development. The settlement of Utah and the economic life of the towns and rural communities have been closely related to agriculture and irrigation development.

Largest Part of Agricultural Income from Irrigated Farms

At present time 80 percent of labor utilized in agriculture is employed on irrigated farms. Of the total agricultural income for Utah, 75 percent is derived from irrigated farming, 20 percent comes from range livestock, and only 5 percent from dry farming (fig. 1). According to range conservationists the number of livestock that can be economically grazed on Utah ranges is limited and the small amount of rainfall in most areas restricts the expansion of dry farming.

It therefore follows that Utah's opportunity for agricultural expansion and development and the addition of new agricultural wealth lies in the further development and more efficient use of irrigation water within the state, including its transfer from the Colorado River to the Bonneville Basin.

Settlement Based on Irrigation

The settlement and use of the land were possible only through the development of irrigation. The building of homes, the growth of communities, and the entire culture of the area have been closely interwoven with the progress and development of irrigation. From the beginning, the construction and use of irrigation facilities were considered community problems, and now, after more than a century of development, the irrigation enterprises are dominantly small, cooperative, mutual companies. With the exception of a few federal projects, irrigation development has been by community groups. It is quite natural that under such conditions and in a pioneer economy, the development should include only the lands and water facilities that could be most economically developed. A program for development of all the land and water resources is a vital need for Utah.

As a result of this type of development, some irrigated lands have an inadequate water supply and some of the better lands have no water at all—yet in some places water remains unused. The financial requirements for developing these resources, however, are beyond the capacity of community groups alone.

Settlement in nearly all parts of the state followed the village pattern.

(*Continued on page* 19)

The magic touch of water to an arid seedbed turns unproductive land into valuable farms. In this sugar beet field the seed has been planted and the water from an irrigation project is being used to germinate the seed

In the lower picture sprinkler irrigation maintains optimum conditions for a sugar beet crop

Colorado River Storage Project Key to Future Development of Utah's Resources Both Agricultural and Industrial

CLEVE H. MILLIGAN

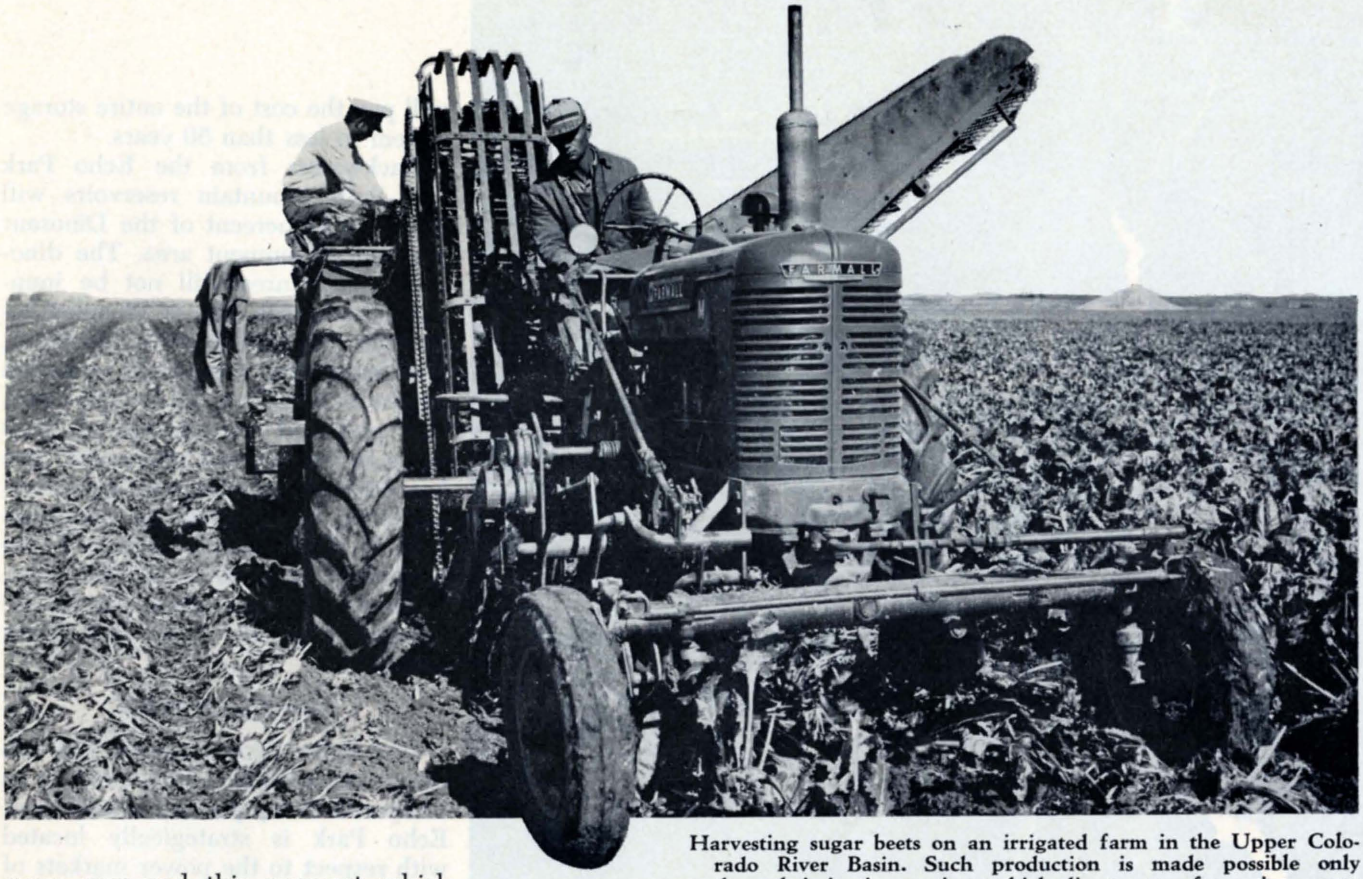
UTAH has coal, oil and oil shales, chemicals, metals, land, hydroelectric power sites, an agreeable climate, beautiful scenery, and industrious people. Nearly all of the ingredients for a great culture and a great agricultural and industrial economy are present. The development of these great inland resources is important to the future prosperity and security of the people of Utah and of the nation as a whole. Water and power are the limiting factors in the development of these great resources. If water and power can be made available, then these resources can be developed. If they cannot, then many of these great natural resources may lie dormant forever. This would be a tragedy for Utah and for the nation. Water and power are the catalysts needed to bring about the desired reaction among these valuable resources. The Colorado River is the only remaining water supply of significance for the integrated development of Utah and of the upper basin states.

Planting of orchards in the Upper Colorado River Basin is possible only because of irrigation projects. These lands are increased in value several times because of water. Much of the nation's supply of fruits is produced under irrigation

PROFESSOR CLEVE H. MILLIGAN is head of the Department of Irrigation and Drainage. He has made a number of investigations on consumptive use of water in the Colorado River basin.

The Colorado River Compacts

The Colorado River originates in and flows through seven states, Colorado, Wyoming, Utah, Arizona, New Mexico, Nevada, and California. It has a natural division point between the upper and lower basins at Lees Ferry, Arizona, about 28 miles below the Utah-Arizona state line. In 1922 all of these states, except Arizona, entered into the Colorado River Compact which provided the basis for division of the river water between the upper and lower basin states. Each of the states and the national con-



Harvesting sugar beets on an irrigated farm in the Upper Colorado River Basin. Such production is made possible only through irrigation projects which divert water from rivers onto the fertile, arid soils that without water are of little value

gress approved this compact which provided a basis for the future regulation and development of the Colorado River.

This compact guarantees that over a 10-year period, 75,000,000 acre-feet of Colorado River water must flow past Lees Ferry in Arizona to the lower basin states. This is probably more than half of the water of the Colorado River, although about 90 percent of the water originates in the upper basin states of Utah, Colorado, Wyoming, and New Mexico. The signing of the compact made possible several developments on the lower Colorado River, including such projects as the Hoover, Davis, Parker, Headgate Rock, Morelos, and Imperial Dams, the Pilot Knob Power Plant and Wasteway, and the All-American Canal, all for the benefit of the lower basin.

No Development in Upper Basin

Since 1922, practically no development has taken place in the upper basin, but since 1932 approximately $500,000 has been available to the U. S. Bureau of Reclamation for investigations in the upper basin in cooperation with the respective states. In 1948 the upper basin states agreed on their respective shares of the Colorado River by compact. This compact allots 23 percent of the upper basin water to Utah.

Although the Colorado River Compact of 1922 allots to the upper basin states the second 75,000,000 acre-feet each 10-year period, the lower basin is now utilizing for power generation much of the water which belongs to the upper basin. If present use were to continue, there is a possibility that a prescriptive water right may be established. This would make it impossible for the upper basin states ever fully to develop their water, power, and other resources in spite of the compact. Consequently, the upper basin states should develop means of using their water as soon as possible. This is particularly important in view of the fact that it will require 25 to 30 years to construct the initial phases of the project, over 20 years to fill the reservoirs in the storage project, and 100 years to develop complete utilization of the upper basin's share of the water.

The Colorado River Storage Project

In 1946 the U. S. Bureau of Reclamation, after years of investigations by competent engineers, issued a report, "The Colorado River Storage Project and Participating Projects," which recommended a plan and facilities for the development of the upper basin. This is a comprehensive, integrated plan, which along with the developments already constructed in the lower basin, provides for the development of the entire Colorado River within the provisions of the compacts. There are two main phases of the proposed upper basin development: (1) the Colorado River storage project, and (2) the participating projects.

The Colorado River storage project proposes construction of a team of nine reservoirs at strategic places for the regulation of the river. The regulation is essential if the upper basin states are to have water for the participating projects and still deliver the required volume of water to the lower basin states. Studies indicate that the upper basin must provide holdover storage for over 20,000,000 acre-feet of water to deliver the required volume of water downstream in dry years. The annual discharge of the Colorado River at Lees Ferry

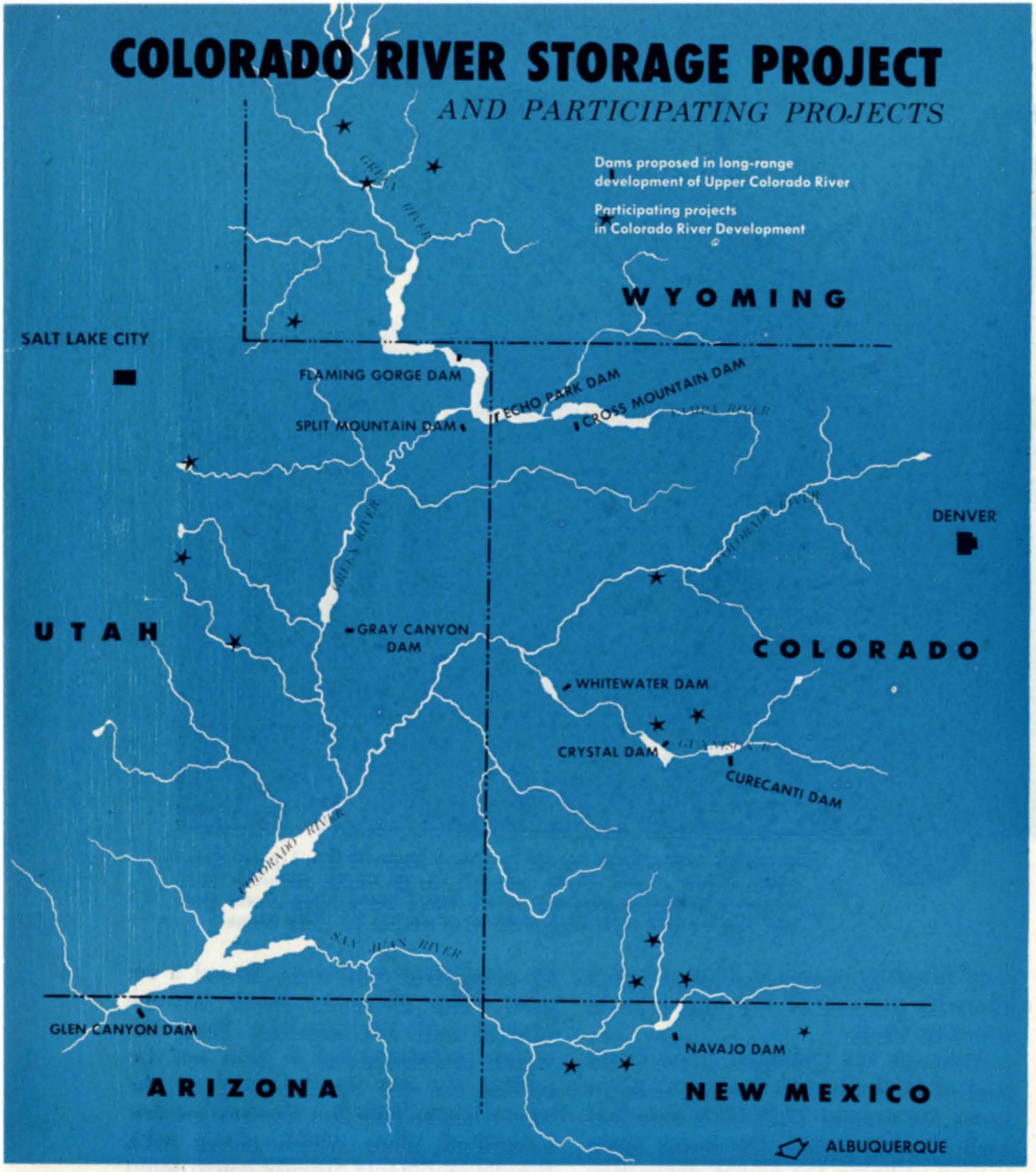


Fig. 1. The Upper Basin Project bill now before Congress proposes six major dams at Glen Canyon, Echo Park, Cross Mountain, Flaming Gorge, Curecanti, and Navajo

has varied from a minimum of 4,000,000 acre-feet to a maximum of 23,000,000 acre-feet since 1922. This erratic flow makes regulation of the river essential.

The Colorado River storage project proposes dams at the following sites: Echo Park, Glen Canyon, Split Mountain, Ashley, Cross Mountain, Gray Canyon, Crystal, Whitewater, and Blue Mesa (fig. 1). The total storage capacity of reservoirs created by these dams would be over 47,00,000 acre-feet which would give complete regulation of the upper Colorado River and provide for silt storage for 200 years. Hydroelectric power plants at these dams would have a combined output of 1,592,000 kilowatts.

Complete regulation of the Colorado River for maximum benefits cannot be accomplished by one or two reservoirs. A team of nine reservoirs is needed. Rigid standards were utilized in the selection of each of the nine proposed reservoirs and in selection of the team of reservoirs. Elimination of any of them will adversely affect the utility of each of the others. This is particularly true of the Echo Park and Glen Canyon units which are the key units. Removal of these units from the team would be like trying to build a championship football team without a center and a quarterback. These two units produce two-thirds of the storage and power at one-half the cost of the total storage system. Power revenues from the storage project will pay the cost of the entire storage system in less than 50 years.

Backwaters from the Echo Park and Split Mountain reservoirs will inundate 11 percent of the Dinosaur National Monument area. The dinosaur quarry area will not be inundated since this area is 25 miles below the proposed damsite. Moreover, the inundated formations antedate dinosaurs by about 100,000,000 years. The proposed construction of these dams in the national monument area has created considerable opposition. However, the presidential proclamation of 1938, which expanded the monument from 80 to 203,885 acres, made specific reservations for the development of the water and power resources.

Echo Park Reservoir

The Echo Park reservoir site has many remarkable characteristics as compared to any possible alternatives. Echo Park is strategically located with respect to the power markets of the upper basin. Percentage-wise, evaporation losses would be less from the Echo Park reservoir than from any other reservoir. The loss of reservoir storage space because of sediment would be less than at other comparable sites. Use of alternative sites would increase evaporation losses approximately 120,000 acre-feet per year, enough water to irrigate about 50,000 acres or to provide a water supply for a city of 600,000 people. Losses in power would be approximately 188,000 kilowatts. The Echo Park reservoir would strategically control the Green and Yampa rivers and contribute materially to the feasibility of the Flaming Gorge, Cross Mountain, Split Mountain, and Gray Canyon units. The construction of the Echo Park dam will not destroy the beauty of the Dinosaur National Monument but will increase its utility. Most of the area now is inaccessible to the majority of the people. Development of the water and power resources will make much of the area accessible to all of the people.

The Contributing Projects

The proposed storage projects would regulate the river and make

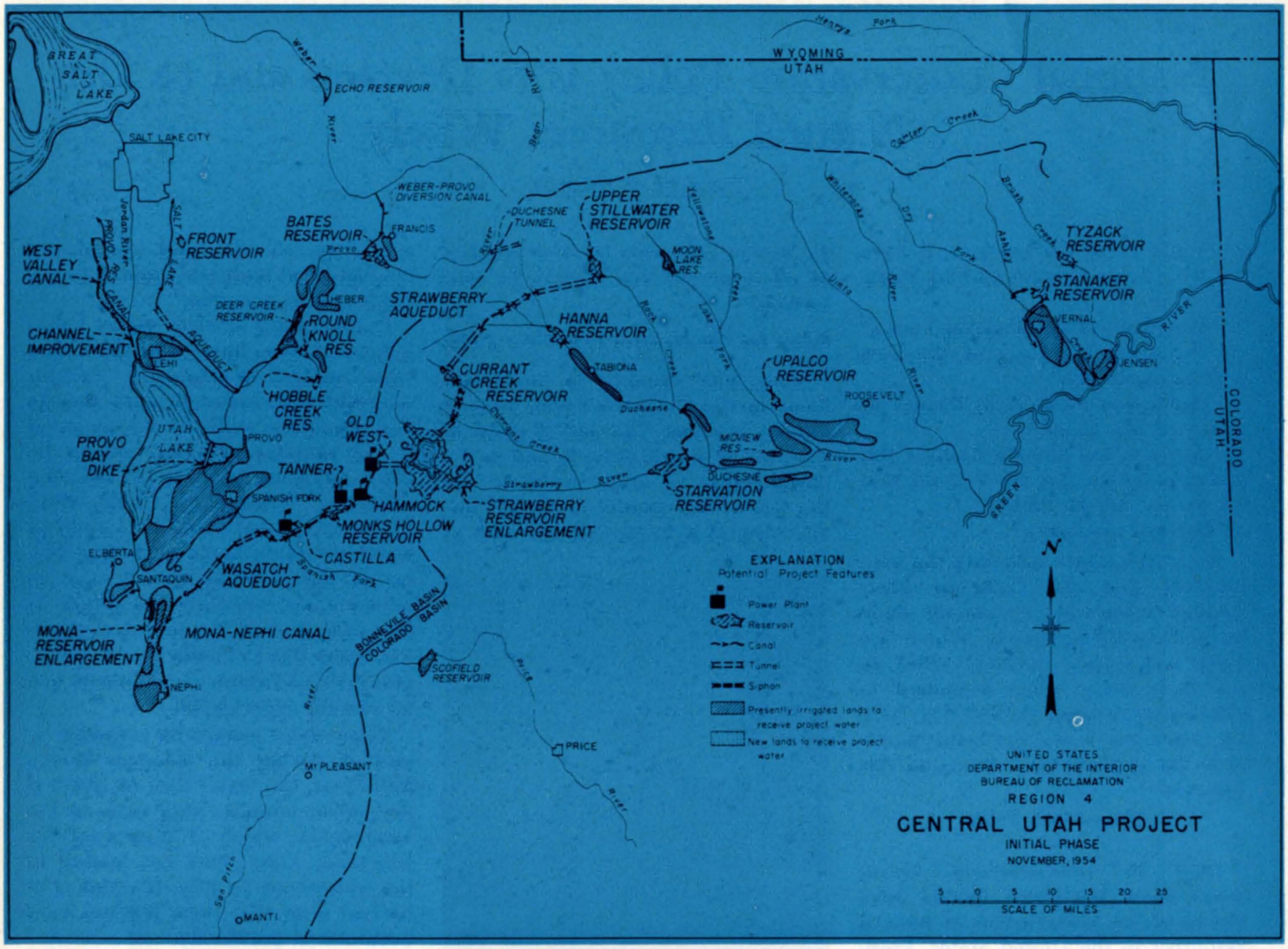


Fig. 2. The Central Utah Project, the initial phases of which are shown above, is the largest of the eleven contributing projects of the Upper Basin Project. This project will transfer most of Utah's share of the Colorado River water to the Bonneville Basin

possible the generation of power. The contributing projects would make consumption of the water possible. Each of the upper basin states has a number of potential contributing projects which will provide water for irrigation, industry, municipal uses, and for generation of hydroelectric power in addition to the power generated by the storage project. The storage project would provide water for the participating projects. Consequently, the contributing projects are fully dependent upon the storage project. The participating projects would further benefit from the storage project by receiving repayment assistance through power revenues that are in excess of the repayment requirement of the storage project itself.

More than 100 potential irrigation and multiple-use projects have been inventoried in the upper basin. There is insufficient water for all of these projects, but the Colorado River will supply a substantial part of the potential needs.

Central Utah Project

Initial authorization of 11 participating projects has been recommended by the Secretary of Interior. Other projects will be investigated and reported as they are justified. The Central Utah Project is the largest of the 11 contributing projects (fig. 2). The initial phases of these projects will cost more than 231 million dollars. Two major features of the Central Utah Project will be (a) an aqueduct approximately 110 miles long to convey water from the south face of the Uinta Mountains to the Bonneville basin and (b) enlargement of the Strawberry Reservoir from its present capacity of 283,000 acre-feet to 1,370,000 acre-feet. The Central Utah project is the only plan under which Utah can put to beneficial use the Colorado River water allocated to her by the compact between the upper basin states.

The Central Utah project will bring under irrigation over 200,000 acres of new land. A supplemental water supply will be furnished to 240,000 acres of additional land now with an inadequate water supply. Water will be available for municipal and industrial uses. The project will produce 1,200,000,000 kilowatt hours of electrical energy annually. This project will make it possible for Utah to double its population and to develop its great resources.

National Conservation Policy is to Develop and to Use Natural Resources Wisely

THEREL R. BLACK

"First thing we know we'll have a steam laundry on Old Faithful."

"They'll cover the dinosaur bones."

"The natural scenery of the area will be destroyed."

"The upper basin is in danger of losing its life blood."

"Congress has already decided this question by passing the Federal Water Power Act in 1921."

"It is too expensive."

Such statements reflecting the controversy over the Colorado River Storage Project are commonly made by well-meaning people. Which are myth and which are fact? What do the facts mean when examined in relation to national policy? This article considers some pertinent points of national policy as it bears on this project.

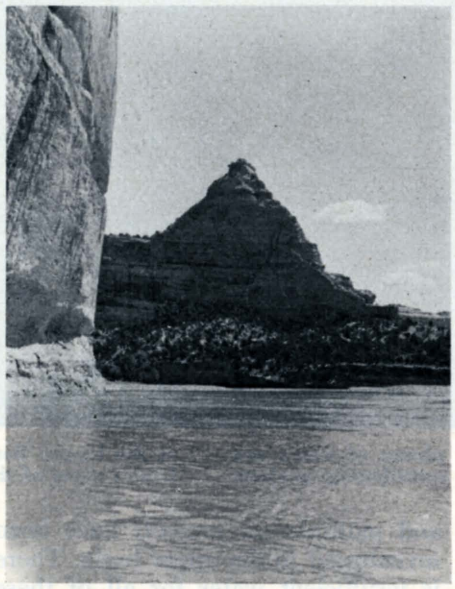
Conservation Policy

Only in comparatively recent times have farsighted people seen the need for conservation of natural resources in the United States. President Theodore Roosevelt and Clifford Pinchot took an active part in instigating the conservation movement. This movement and practice are based upon the realization that serious wastes of natural resources, if continued unchecked, can impoverish both present and future generations, and that, therefore, natural resources must be wisely used, conserved, and developed. Examples of resources that are usually included in conservation thinking are soil, water, forests, plant life, and wild life. A broader conception also includes scenery, recreational potentials, and similar social wealth. And basic to all conservation are present and future human needs which will be satisfied by the conservation. To emphasize this point recent tendency refers to human resources as the greatest of all resources that should be conserved.

DR. THEREL R. BLACK is assistant professor of sociology. He has been a member of the Experiment Station staff since 1951.

Points for Consideration in a Water Policy

The major resource in immediate focus in the Colorado River Storage Project is water. The part it plays in the lives of people directly and in the development of other resources for the use of the people is of first importance. It is impossible to think of



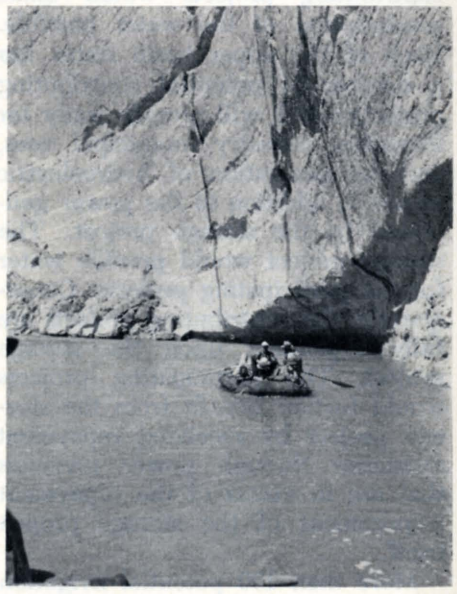
Rock figures in Hardings Hole area 20 miles above Pat's Hole

any human endeavor that does not require water. However, water is limited. According to the President's Water Resources Policy Commission, reporting in 1950, two facts stand out clearly. The first is "that water is limited in relation to the many and varied needs for its use": increased domestic uses as population grows, irrigation on new lands in the West and on lands only partially irrigated at present, and new industrial and atomic power industries. The second fact is that "the management, conservation, and use of water resources are inextricably bound up with the management, conservation, and use of our land and that both are essential to our expansion as a nation."

Conservation of river water looms important, even in areas of the nation where rainfall is abundant. "As consumptive uses increase more storage for regulation will become essential if the supplies of water are to be made adequate to meet the growing demands." (George D. Clyde, Utah Water & Power Board.) If scarcity of water threatens to be a limiting factor of national importance even in humid areas, certainly the plight of that arid part of the nation dependent upon the Colorado River for its present and future development can be readily appreciated.

Since water cannot be renewed by rainfall during the summer in the arid West, the water flow of rivers is dependent upon melting snow in the watersheds, which is then used for irrigation. Most snow has melted in the watersheds by July. If water is to be had after that time, it must have been stored previously.

Closeup view of typical overhanging rock eight miles upstream from Pat's Hole. Such sights would be accessible from clear water lake made by Echo Park dam

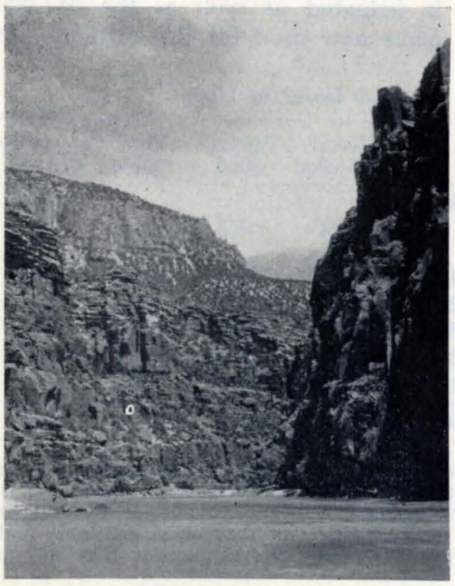


Water Bags

As one drives west across the continent, he begins to notice more and more cars with water bags attached to the front bumpers. Few drivers risk a long trip in the dry country without a reserve of stored water. These water bags are symbolic of the needs of the entire arid West. Huge "water bags" must be filled in the mountains when the snow melts to be used after there is no snow. These "water bags" are multiple purpose reservoirs caused by damning up a flowing river.

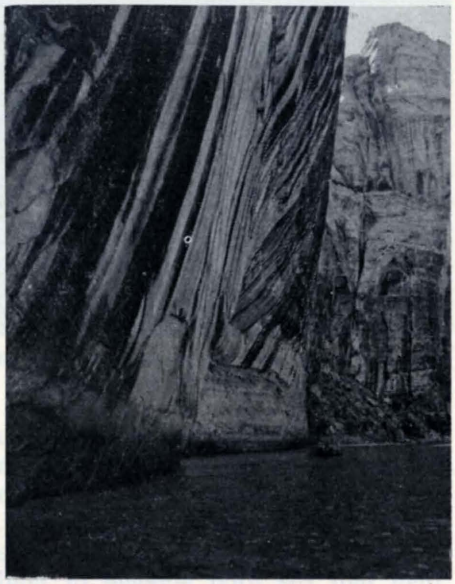
The changing attitude and practices toward water of the tourist as he travels east to west are representative of the changed attitudes and practices toward water that were necessary developments before the West itself could be colonized. Legal doctrines regarding property rights in water shifted from those of riparian rights (where the water of a stream could not be diverted), to appropriation (where diversion was possible) and finally to rights agreed upon by compacts before the water is used, such as the Colorado River Compact. Future development of the arid sections of the West can go forward only on the basis of the continued realization that water conservation and water rights are practiced differently in humid and arid sections of the nation. As the populations of the huge cities of the East come to recognize the importance of water conservation for their increased needs, they are able to understand better the importance of the national water conservation policy for the arid West.

View of Echo Park damsite. The maximum water surface which will be 525 feet above the streambed will come to the base of the stratified formation. This reservoir will be the most efficient on the entire Colorado River system



Use of Water

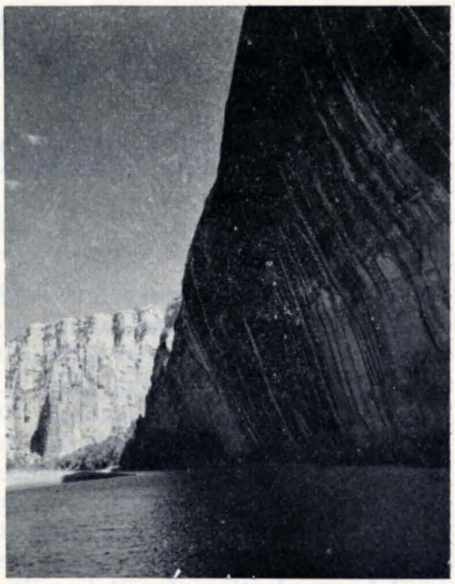
In the national water conservation policy are some important elements to keep in mind in relation to the use of water in the Colorado River. Water can be used either consumptively or non-consumptively. Examples of consumptive uses are domestic, municipal, agricultural, and industrial uses. Non-consumptive uses include water for the development of power, for navigation, for recreation, disposal of public wastes, and wildlife.



Giant overhanging cliffs about three miles upstream from Pat's Hole on the Yampa are typical of the deep canyon beauty that will be accessible to millions with the completion of Echo Park Project

The most important of these two major types of uses of water is consumptive use. "For consumptive uses", according to George Clyde, "there is no substitute," while for "non-consumptive uses, except possibly the disposal of public wastes, substitutes can be obtained."

One important consumptive use of water is for domestic and municipal use. The Land Economist Wehrwein points out that in arid countries water at times may be so scarce that it is often restricted for drinking only, and bathing and other domestic uses are regulated. In humid areas scarcity of water is reflected only in certain cities which may have grown beyond water supplies within easy reach.



Picturesque sheer undercut wall with castle-like formation in left background. About six miles above Pat's Hole on Yampa River

Other consumptive uses of importance which draw upon water are industrial and agricultural in nature. Few indeed question the possibility that industrial expansion will continue in the future, and that with this expansion goes important needs for water. A national policy for water must allow now for such future developments.

Need for Agricultural Products

The importance of the agricultural use of water is related to the demand for present and future agricultural products. In the United States, as in any nation, the size of the population now and its expected size for the future are important elements in the estimate of agricultural needs. In spite of present United States surpluses in some farm products, authorities variously estimate that one-half to two-thirds of the people in the world go to bed hungry every night. The population of the world

(*Continued on page* 18)

Land is Plentiful . . . Only Water is Lacking

W. PRESTON THOMAS

Acreage of Arable Lands

DATA from soil survey and land classification investigations indicate that there are about 3,176,000 acres of arable land in Utah (table 1). According to these investigations, 70 percent of these arable lands are in classes 1 and 2, which is evidence that the quality is satisfactory for high crop production. The 30 percent of arable lands classed as 3 can be used for production of certain cultivated crops and for irrigated pasture.

Present Uses of the Arable Lands

Of the total of 3,176,000 acres of arable land in the state, 1,019,400 acres, or 32 percent, are irrigated at the present time, but only 13 percent of total arable land has a full water supply (table 2). An additional 517,000 acres, or 16 percent, are used for the production of dry land crops. This leaves slightly more than half of the total arable land, 1,639,600 acres, unused except for grazing. This is not a desirable balance in land use in a state where only 6 percent of the total area is arable. Of the total irrigated land, only about 40 percent has an adequate water supply. The remainder is normally in short supply. The shortage may vary from not any in some years to a supply of only flood waters in most years. In many respects the supply shortage on the lands now irrigated is more detrimental to the well-being of the farm people than is the fact that more than half of the arable land is only used for grazing.

The Weber River-Utah Lake drainage basin has the largest acreage of irrigated land of any basin. The largest percentage of the lands in that basin, about 72, also has a full or adequate supply. The next largest area of irrigated land is in the Sevier River basin. However, in the Sevier basin only about 13 percent of the irrigated land has a full water supply.

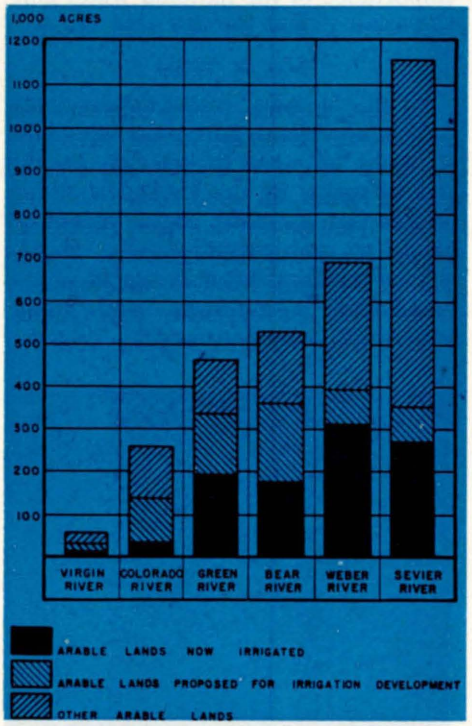


Fig. 1. Present and proposed future use of arable lands in Utah by drainage basins

In addition to the Sevier, less than 20 percent of the irrigated land in the Colorado River and the Virgin River basins has an adequate supply.

The Bear River basin contains more than half the total acreage of land used for dry farming. The Sevier River and the Weber River-Utah Lake are the other important dry farm areas.

The Sevier River basin contains nearly half the arable land now used only for grazing. The basin with the next largest area of non-cultivated arable land is the Weber River-Utah Lake basin. These basins are most favorably located with respect to markets and possible future industrial development. The Bear River basin contains relatively the least arable lands that are not used for arable purposes. This results largely from the fact that the precipitation is sufficient to use those lands for dry farming. This cannot be done in most parts of the state. However, if irrigation water were available, the productivity of the dry farm lands would be materially increased by the application of water.

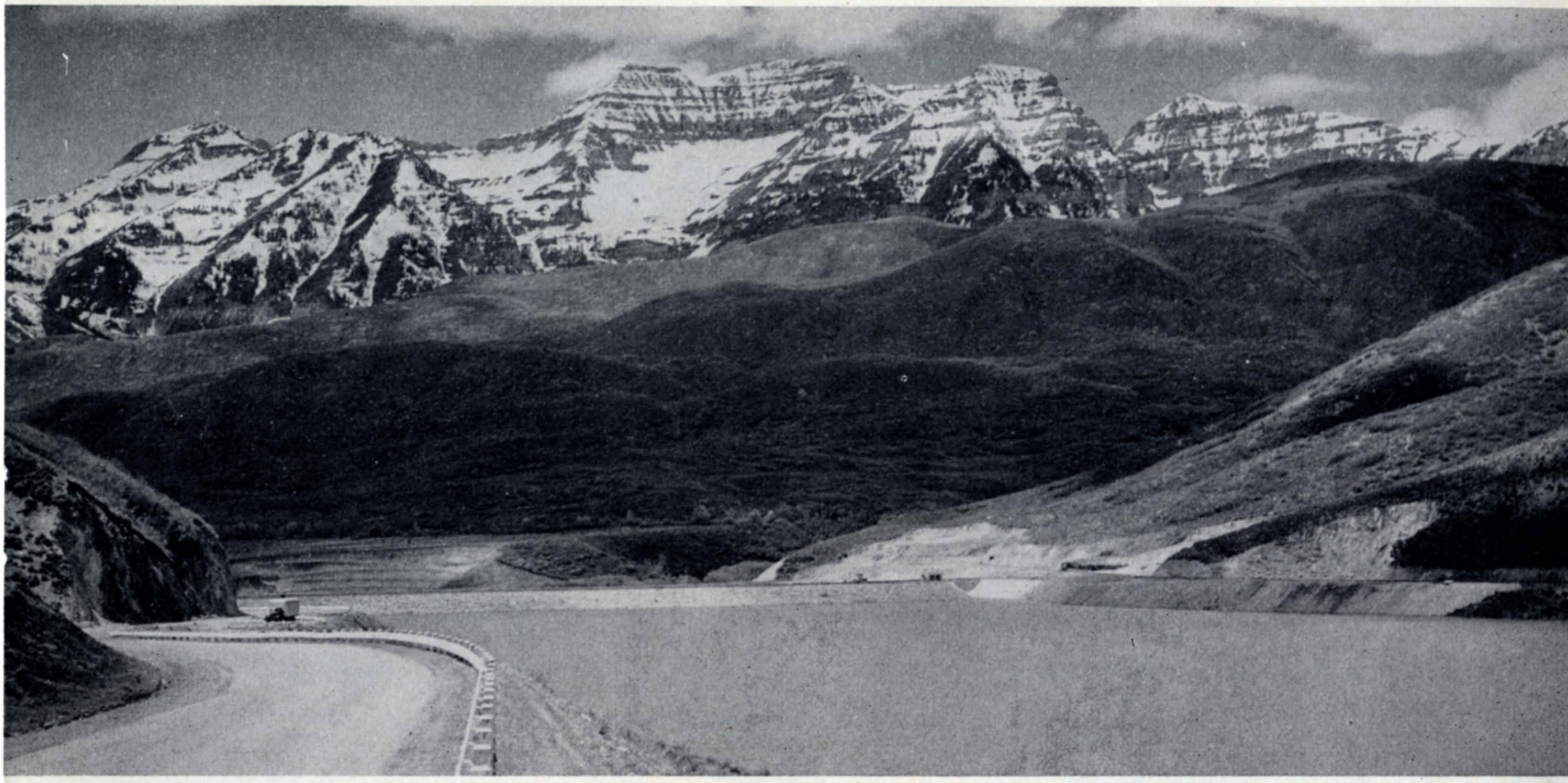
Limitations to More Intensive Use of the Arable Lands

Lack of irrigation water is the factor that has limited the acreage of arable land to less than 50 percent of the potential acreage. It also limits the intensity of use and productivity of about 60 percent of the land that is irrigated as well as the 517,000 acres now used for dry farming. In

Table 1. Acreage of known arable land by drainage basins in Utah

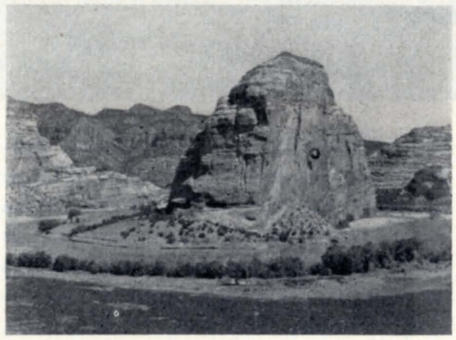
Drainage basin	Land class 1	Land class 2	Land class 3	Total classified	Unclassified	Total arable	Percentage of total
	1,000 acres						*percent*
Bear River	15.1	38.0	.3	53.4	478.8	532.2	17
Weber River-Utah Lake	145.3	283.1	213.0	641.4	53.0	694.4	22
Sevier River	156.6	274.6	226.8	658.0	511.3	1,169.3	37
Green River	36.5	198.5	85.7	320.7	145.9	466.6	14
Colorado River	19.2	144.8	68.9	232.9	27.3	260.2	8
Virgin River	11.6	12.4	14.9	38.9	14.4	53.3	2
Total	384.3	951.4	609.6	1,945.3	1,230.7	3,176.0	100

All available sources of information were investigated to find the land resources data in this table. The important sources were: records of (1) The Reclamation Bureau, (2) Soil Conservation Service, and (3) soil survey division of Utah Agricultural Experiment Station. For areas where no soil survey or land classification data were available and census data would apply, the census data were used under the assumption that all the cropped land was suitable for arable uses.

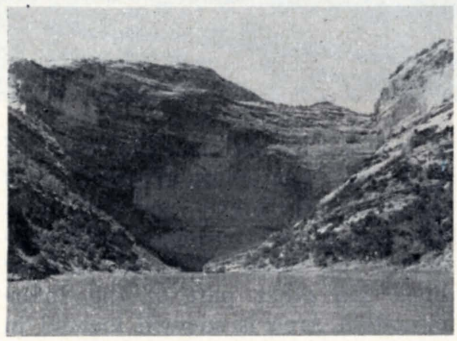


Deer Creek Reservoir with dam and Mt. Timpanogas in the background. In reservoirs such as this water from melting snows is stored for use on farms when natural streamflow is not available

View of Pat's Hole area at junction of the Green and Yampa Rivers. Yampa enters picture from the left, Green from the right. The combined stream flows around point of Steamboat Rock



Steamboat Rock showing circuitous course of Green River which flows from junction with Yampa at right to left. Maximum water surface will come approximately one half way up on rock

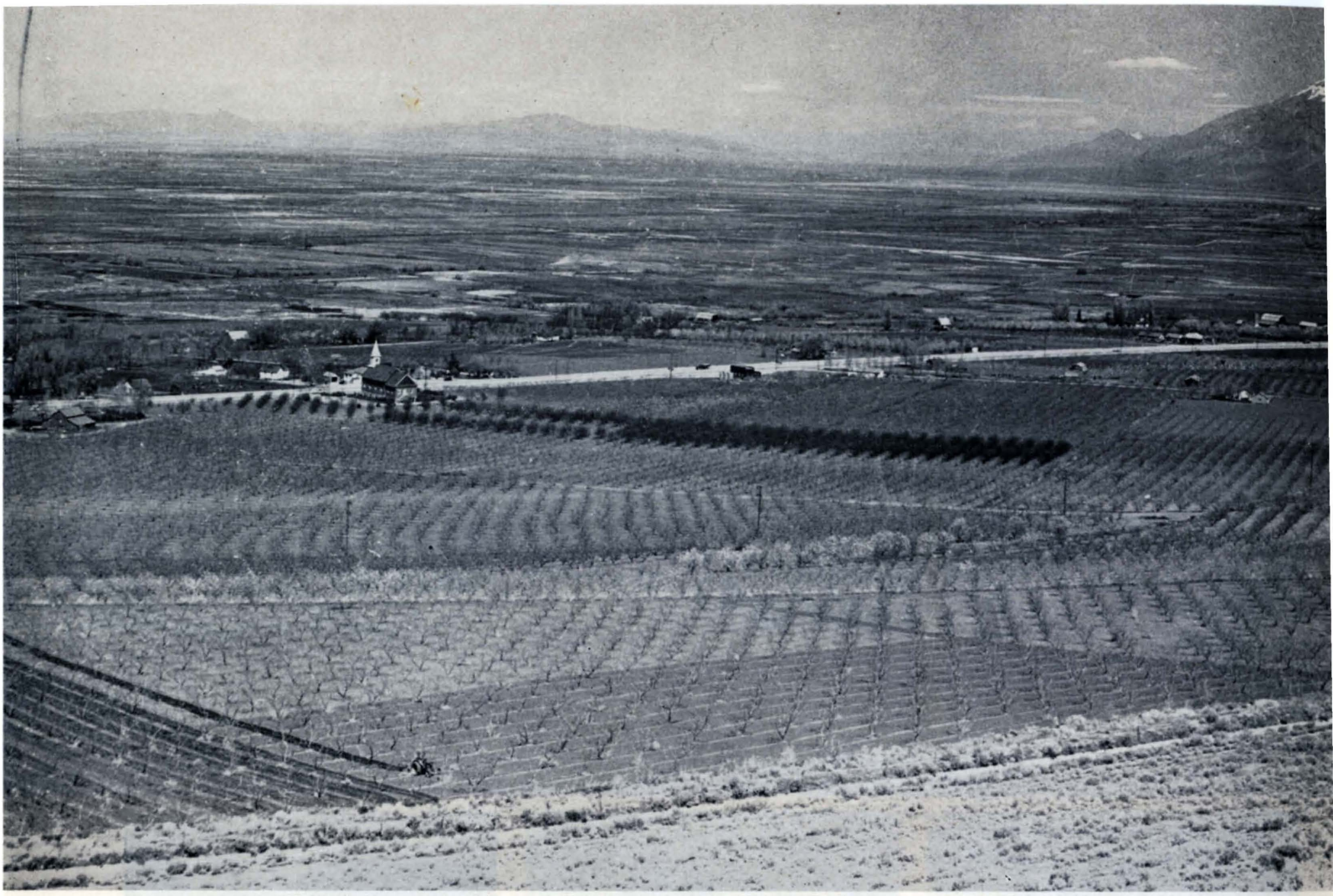


Looking downstream from a point 7 miles above Pat's Hole. Dark waterstains on rock indicate extent of overhanging. Maximum water level of lake would come up one-fourth way on face of rock

some drainage basins, particularly the Sevier River, Virgin River, and part of the Weber River-Utah Lake, the water is not present anywhere in the basin. In basins such as the Green and the Colorado where water is available, it is often so located that it would be costly to apply to the lands. Financial cost prevents local communities and often the state from developing facilities necessary for irrigation. Such development must be made by the federal government if they are to be built.

Table 2. Present use of the known arable lands by drainage basins in Utah

Drainage basin	Irrigated			Dry farmed	Not used for crops	Total arable
	Full-supply	Partial supply	Total			
	1,000 acres					
Bear River	77.0	101.1	178.1	282.6	71.5	532.2
Weber River-Utah Lake	225.3	89.2	314.5	93.0	286.9	694.4
Sevier River	36.0	238.9	274.9	101.3	793.1	1,169.3
Green River	61.7	133.6	195.3	0.9	270.4	466.6
Colorado River	4.2	33.5	37.7	33.2	189.3	260.2
Virgin River	3.5	15.4	18.9	6.0	28.4	53.3
Total	407.7	611.7	1,019.4	517.0	1,639.6	3,176.0



UTAH is located near the center of the Intermountain Area. It is the hub of the eleven western states. Through it pass the major transcontinental rail lines, highways, and air lines. No other part of the Intermountain Area is so well located in relation to ready accessibility to the important cities of California, the Pacific Northwest, and the East. The concentration of farms and irrigated lands is greatest, of any part of the state, in the north-central section along the Wasatch Range of mountains. These mountains are adjacent to the major cities, and it is in this area that the important highways and rail and air lines bisect.

Agricultural Strength

Utah's agricultural strength is in her institutions and farm people. These two assets have been dominant in the development of agriculture, industry, and community life in this state.

In the agricultural areas in Utah the community and institutional patterns are generally desirable. A large majority of the farms in the state have available within a reasonable distance such community institutions as schools, including high or secondary schools, churches, retail stores, and service establishments. The majority also have medical, dental, and hospital services. Electrical services, telephone services, roads, and marketing facilities are available to the majority of the farms.

A second asset is the farm people. Most of them are reasonably well educated, they cooperate well together, and are making good use of the resources at their disposal. The basic philosophies of the majority lend stability and dignity to their business and profession.

Weaknesses in Utah's Agriculture

The two major weaknesses in Utah's agriculture are the small size of the average farm and an inadequate supply of irrigation water. The impact of these weaknesses is upon, first of all, the income from farming. The state was settled under conditions that made small farms necessary. With natural increase in population that has been relatively high for even a rural pioneer area, this problem has not been corrected with the passing of years. Lack of employment opportunities in nearby trade

NEW PUBLICATION

Bul. 373. Biennial report of the Utah Agricultural Experiment Station, 1952-1954.

This is a statistical report giving a few of the results of research, the organization of the experiment station, the location of the research activities, a list of projects and cooperative agreements, a list of research grants, service activities of the station, publications issued, personnel changes, and a list of the staff.

Copies of this publication will be sent on request to the Utah Agricultural Experiment Station, Logan, Utah.

Irrigation water makes the difference between the land in the foreground and the prosperous orchards in the center of the picture. The Ogden-Brigham Canal separates the two areas. The picture is taken looking north toward Brigham City from high point on north side of Perry Canyon. Wellsville Peak in background. Picture courtesy U. S. Bureau of Reclamation

Strength, Weakness, and Needs of Utah's Agriculture

Her strength is in her farm people and her institutions

Her weakness the small size of farms and lack of water

Her need is water

W. PRESTON THOMAS

or industry has kept the population large in relation to the farm lands. A fundamental need for these farms is to increase the size of business; that is, to provide more productive employment on the farms. This can be done by expanding acreage of cropland per farm or by using existing lands more intensively. In most areas of the state neither is possible at present because of a lack of irrigation water. More water is the great need. The impact of this need is upon the net family income and economic well-being of the farm families and the economy of the state.

A second weakness of Utah's agriculture is in its inability, because of inadequate irrigation water, to adjust the type of farming to meet the present demand of the markets that Utah farms are in the most advantageous location to supply. The result of this affects not only farm income but also the well-being of the consumers in those markets. The home market and the California market normally need, for example, more dairy products, more slaughter beef, more pork and pork products, more chicken meat, more potatoes, and similar products. Because they cannot be produced here, it is necessary to pay transportation costs on them from the Middle West. In some cases, beef for example, the animals are shipped from Utah, Nevada, or even California to the corn belt for fattening and then back to the coast for consumption. The only reason for this is that it is not possible under existing conditions to produce sufficient feed to fatten cattle here. Additional land is available for the production of feed, but sufficient water is not available to irrigate the land. All other factors necessary to satisfactory production exist here in abundance: soil, climate, labor, institutions of every kind, and competent management. Only water for irrigation is lacking.

Water and a Prosperous Agriculture

With adequate irrigation water, existing farm businesses could be enlarged by irrigating and cropping land that is now used for grazing, or by using existing cropland for the production of more intensive crops, or by increasing the yields of the same crops, or by all three means. Lands that are now growing forage and feed crops could, with adequate water, grow fruit, truck crops, or such crops as potatoes, sugar beets, or canning crops. Some lands now yielding 1½ to 2 tons of hay or 30 to 35 bushels of barley could with adequate water yield 4 to 5 tons of hay or 60 to 70 bushels of barley per acre.

In addition to increasing the intensity and the productivity of the existing farms, many new farms could be developed. The surplus labor on the existing farms could farm new lands. The new lands could be just as productive or even more productive than many of the existing croplands. Furthermore, since the new lands are in the vicinity of established communities, they could immediately, at little expense, have all the benefits of existing institutions.

Increased farm production mean increased agricultural income of at least 60 percent. This would also be accompanied by the removal of a great deal of uncertainty and anxiety about the security of the income. This is especially important in areas where supplemental water is to be supplied. Increased agricultural income would, of course, mean greater income to the non-farm population. Additional income would also extend the tax base. The irrigation development is an integral and important part of the total economic expansion of the West made possible through the power and water resources available with development of the Colorado River.

Additional Water Means Greater Land Development

Means new water to 1,014,300 acres
Means increase of 50 percent or more in irrigated land
Means 75 percent increase in irrigation water

W. PRESTON THOMAS

Lands to Benefit from Water Development

At present time Utah's irrigated area is 1,165,100 acres. Of this acreage only 32 percent has an adequate water supply and 68 percent has a partial supply (table 1). Tentative plans for the development of additional irrigation water for Utah would use the new water to benefit 1,014,300 acres of land (table 1). Of this total, 406,900 acres would be land now inadequately irrigated and 607,400 acres of land that is not irrigated at present.

With the proposed development, total irrigated land in the state would be increased to 1,772,500 acres, which is 52.1 percent more than the area now irrigated. In addition to the increase in total irrigated area, 406,900 acres now inadequately irrigated would receive a full supply. This is more than half of the area now inadequately irrigated.

Water Supply

Utah's present water supply for irrigation use is 2,875,400 acre-feet, proposed additions through development are 2,163,400 acre-feet making a total of 5,058,800 acre-feet, an increase of 75 percent (table 2). The percentage increase from the Bonneville Basin is 29 and 261 from the Colorado Basin.

Practically no additional water in Utah can be developed by direct diversion of natural streamflow. The natural late season flow of all of Utah's streams was appropriated years ago. The high spring runoff not yet appropriated would be of little value without a storage supply later in the season. Therefore, new supplies can be had only by storage. Essentially the entire amount of any new water would have to be impounded in reservoirs. The capacity of existing reservoirs may be enlarged in some cases, but the major need is for new reservoir construction. Some of the reservoirs would be fairly large, but many small ones have been proposed. For developments within the Bonneville basin, the Bear River and its tributaries, and the Weber River and its tributaries are the most important sources of water for storage.

The proposed water development from the Colorado River system would also involve storage. Part of the stored water must be diverted into the Bonneville basin. In the case of the Central Utah project area, transfer of water from the Colorado basin to the Bonneville basin would necessitate some exchange of water within the Colorado River basin. Waters now used in the Uinta Basin would be diverted to the Bonneville basin and replaced by water stored in the Green River and diverted westward.

The water needed annually to irrigate adequately all arable lands is 10,142,000 acre feet. The present supply and amount available for use through development is only 5,038,800 acre feet or about 50 percent of the amount required to irrigate adequately all the arable lands of Utah. It is evident that water is the most valuable resource of the state and therefore important that the 2 million acre feet of available water for development should be put to economic use.

Table 1. Areas of land now irrigated and areas proposed to benefit from future development of additional water supplied Utah

Item	Utah
	1,000 acres
Land now irrigated	
Adequate water supply	407.5
Partial water supply	757.6
Total irrigated	1,165.1
Land proposed for additional water	
Now receives partial supply	406.9
Now receives no water	607.4
Total land to be benefited	1,014.3
Total irrigated land after proposed irrigation development	1,772.5

Table 2. Summary of annual present and proposed future supply of irrigation water by sources, Utah

Item	Bonneville basin	Upper Colo. basin	Total Colo. and Bonneville basins	Virgin basin	State total
			1,000 acre feet		
Present supply	2,277.5	552.9	2,830.4	45.0	2,875.4
Proposed additions	665.9	1,441.2	2,107.1	56.3	2,163.4
Present and proposed additions	2,943.4	1,994.1	4,937.5	101.3	5,038.8
Percent increase	29.0	261.0	74.0	125.0	75.0

Consumptive Studies Provide Information on Amount of Water Needed by Various Areas

WAYNE D. CRIDDLE

ONE of the most important elements in the cycle of water movement from the time it precipitates out of the air as dew, rain, or snow until it returns to the air is evapo-transpiration or consumptive use. For good crop production, the consumptive water requirement of the crop must be met at all times regardless of whether the water comes from rainfall, groundwater, or irrigation. This requirement varies somewhat from area to area dependent on cropping practices and climatic factors but for any one set of climatic and crop conditions, it is a rather definite amount.

Fortunately for Utah and other Upper Colorado River Basin States, not all of the water diverted from the streams for irrigation is consumed. Usually a major part of such diverted water finds its way back to the stream either by surface or sub-surface routes. The actual streamflow depletion then becomes the difference between the amount of water diverted from the stream and that which is consumed in the area.

Under cooperative agreement, consumptive use of water studies were begun in the Colorado River area of Utah in 1948 by the Utah State Engineer, the Utah Agricultural Experiment Station, and the Soil Conservation Service.

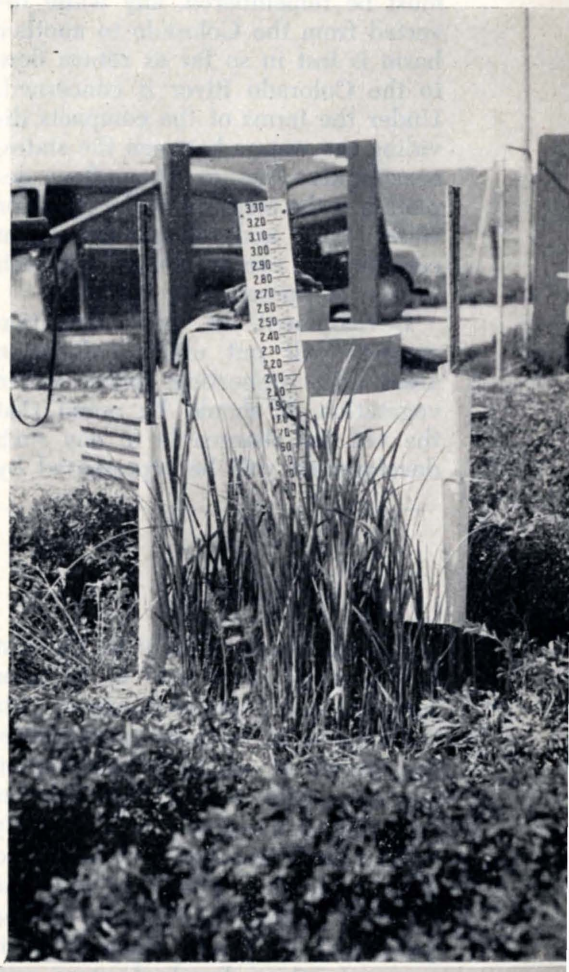
Results of the study at Vernal in the Colorado River Basin show that alfalfa consumes about 37.4 inches and pasture consumes about 35.9 inches of water per year including rainfall. Corn, wheat, barley, and oats all consume about 23 inches of water annually of which about 3 inches is precipitation. Thus, assuming that water which is not consumed by the crop will return to the stream, for every three acre-feet per acre diverted from the stream for irrigation of grains, about 45 percent finds its way back. Similar results were obtained from the studies at Ferron, Utah.

These studies also show that even sparse native vegetation, consisting of scattered sagebrush and grasses, consumes almost an acre foot of water for each acre of land. Heavier growths of vegetation in wet areas use more than four acre-feet per acre each year.

Consumptive Use Studies

For the valley as a whole, it was found that 64,659 acre-feet of water was consumed annually on 34,984 acres of land in Ashley Valley. In Ferron Valley 23,910 acre-feet was consumed on 14,256 acres of land.

From the studies in the Milford Valley since 1951, it appears that about 64,000 acre-feet of water is



In consumptive use studies the use of water by native vegetation is measured in evapo-transpiration tanks (right). Cattails are one of the heaviest users of water. (Lower) Typical evapo-transpiration tanks containing undisturbed soil columns and field crops are used to measure water consumption

WAYNE D. CRIDDLE is professor of irrigation engineering and is employed cooperatively by the Utah Station and the U. S. Agricultural Research Service. He returned in December from a three month special mission to Jordan and Israel as consultant to Special Ambassador Eric Johnston. He returned to the Near East in the middle of January on another such mission. He is among the leading authorities of the United States on consumptive water use.

In 1948 the Utah Agricultural Experiment Station began a study of consumptive use of water in cooperation with the U. S. Soil Conservation Service and the Utah State Engineer. The initial phase of the study was centered in two stream basins tributary to the Colorado River. This phase was completed in 1950 and the results published by the Station as special report 8. In 1951 similar studies were begun in the Milford Valley which is located within the Great Basin and not too far from lands proposed for irirgation under the Central Utah portion of the Upper Colorado Project. Details reported in this article have been taken from these studies.

consumed annually on some 34,000 acres or an average depth, including rainfall, of 1.9 feet over the surface of the land.

Studies Basic to Determine Amount of Water Needed

Without the type of information obtained from this investigation, it is impossible to determine how much water is needed for the land that can be irrigated in the Colorado River Basin of Utah and how much water can be diverted out of the basin for irrigation within the Great Basin. It must be remembered, any water diverted from the Colorado to another basin is lost in so far as return flow to the Colorado River is concerned. Under the terms of the compacts dividing the waters between the states, consumptive use or streamflow depletion is the measure of the right for water. Basic and reliable figures on consumptive use are essential if such a basis of operation is feasible.

Development of new irrigation projects will put under cultivation areas now supporting sparse native vegetation. It should be noted that the net use chargeable to any such development will be represented by the difference between the water consumed by the newly-cropped land and that which was formerly used by the native vegetation. If land now supporting a sparse growth of native vegetation in the Ashley Valley were planted to corn or small grain, the **net increased** consumptive use of water would be less than one acre foot per acre per year. If planted to alfalfa or irrigated pasture, the net increase would be approximately two acre feet over the use by the native vegetation.

A significant saving of the total water allocation of the state could be attained by drainage of water-logged lands which consume 40 to 50 inches of water per season as compared with the 33 inches or so required for alfalfa and about 22 inches for small grains.

In the administration of water rights within the state, and especially on interstate streams such as the Colorado and Bear Rivers, a State Engineer should have available for his use all possible facts about water use in each area of the state. Unit values of consumptive use determined by this investigation can be applied to other areas within the state by taking into account any climatic differences. Some basins, such as the Milford Valley, contain large supplies of ground water. However, these supplies are not inexhaustible. After a period of continuous decline in the level of the ground-water table, the State Engineer closed this basin to further well drilling and appropriation of water. Whether or not it will again be opened for further development is somewhat dependent on the results of the present investigation under way there. If the results show that the land areas, crops, and irrigation practices now used are not fully consuming the available water resources, then the basin will be reopened. If present consumptive use now equals or exceeds the supply, then no further withdrawals will be allowed and it may even be necessary to retract some. Thus the State Engineer finds that consumptive use figures are essential for good administration of the state's water resources. Farmers should also recognize the importance of such data since they should be using it in the design of their irrigation systems and practices. It is fundamental to good irrigation.

CONSERVATION POLICY

(*Continued from page* 11)

has grown more rapidly in the last few hundred years than in all prior ages. As one population expert puts it, "viewed in long-run perspective, the growth of the earth's population has been like a long, thin powder fuse that burns slowly and haltingly until it finally reaches the charge and then explodes." The two and one quarter billions population of the present is over four times what it was only three hundred years ago. While it is true that rates of growth have slowed up in western nations in the recent decades prior to the second world war, it is also true that since the war they have been increasing again. While the postwar increase is thought by some to be a temporary spurt, others estimate that our population will reach 190 millions in about 25 years. Again the importance of water is seen: it is necessary to prevent thirst, and if population of the earth presses the arid sections of the earth to produce food, it is necessary to prevent hunger.

If water of a river basin is to provide maximum use, it is essential that it be considered as a unit from topmost watersheds to the mouth at the ocean. The federal water resource policy is aimed at wise utilization of an entire river system for the many purposes to which the water can be put.

Plans for Use of Colorado River Water

Plans for basin-wide development of the Colorado River, for example, began as far back as 1903, with investigations to determine potential water and power resources of this river. Basin-wide development included the Hoover, Parker, and Davis Dams in the lower basin, as well as proposed dams and related systems in the upper basin.

National water values were being preserved in several instances in relation to the Colorado River Basin. The Federal Water Power Act as amended in 1921, prohibited the licensing of dams, power plants, or other works in national parks and monuments. This amendment was limited to the then "existing" national parks and monuments, with the intent to avoid future tying up of water and power sites by the creation of national monuments. At this time, Dinosaur National Monument was only 83 acres and did not include the deep river canyons. The presidential proclamation of the enlargement of the monument to include these canyons and to specify that water and power development would not be hindered by this enlargement

also underlined national water conservation policy. In addition, the selection of the Echo Park Dam site reflected national water objectives, since saving as much water as possible from evaporation is wise conservation.

To some observers, national water conservation policy in this particular proposed project poses a threat to the conservation of other national resources such as wildlife, scenery, and recreation. It would seem that such observers are like the misinformed first-aid man who applies artificial respiration before he stops severe bleeding. If water is the life blood of the West, it appears that good first-aid applied to the Colorado River is needed in order that national welfare may be served. It is interesting to note, however, that those who are interested in national water conservation policies as well as conservation of other resources find, upon closer scrutiny of the particular features of this project, that threats to fish, game, fowl, scenery, and recreation are relatively non-existent. Rather, conditions created by the project will favor the development of these resources.

Many of the competing interests in the Upper Colorado River Project might well consider what is for the national interest. Many people to whom the conservation of the Colorado River waters is of no vital personal interest might also consider the national welfare. For the welfare of all sections of this great nation and all competing interests is inextricably bound up with the welfare of each section.

SETTLEMENT AND IRRIGATION DEVELOPMENT

(*Continued from page 5*)

The village lot of 1 to 3 acres was the site of the family home, and the village was the center of the farming activities. The croplands and the grazing lands were outside the village and sometimes at considerable and variable distances from the home. This resulted in a noncontiguous land ownership and use pattern. Partly because irrigation made it a necessity and partly because of the philosophy of the early settlers, farm holdings were small. Irrigation systems were developed by cooperative effort of the settlers and usually without benefit of trained engineers, and with only the use of crude mechanical equipment. Time has modified somewhat the original agricultural pattern, but those early characteristics still strongly prevail.

Small Farms Economic Necessity

The small-farm-unit program was partly an economic necessity because of the difficulty of digging ditches for irrigation water and of developing the land. The pioneers had little or no mechanical equipment, so many of the canals were dug by hand. The task was so great that even with group action the canals could not be made of sufficient size to irrigate a large acreage of land for each family.

Need for Full-Time Farm Employment

At present the primary economic need in rural areas of Utah is the opportunity for full-time productive employment of the working force. For part-time farmers and rural nonfarm groups, this opportunity could be in agricultural production or in any other type of economic activity, but for full-time farmers and their families, it should be provided through an enlargement of the farm business. The enlargement of the farm business may be either by the addition of more land or by more intensive use of the existing land. In most areas of Utah either alternative is dependent upon more irrigation water. Expansion of agriculture through any means other than additional irrigation water is unlikely for any significant part of the farms in the state.

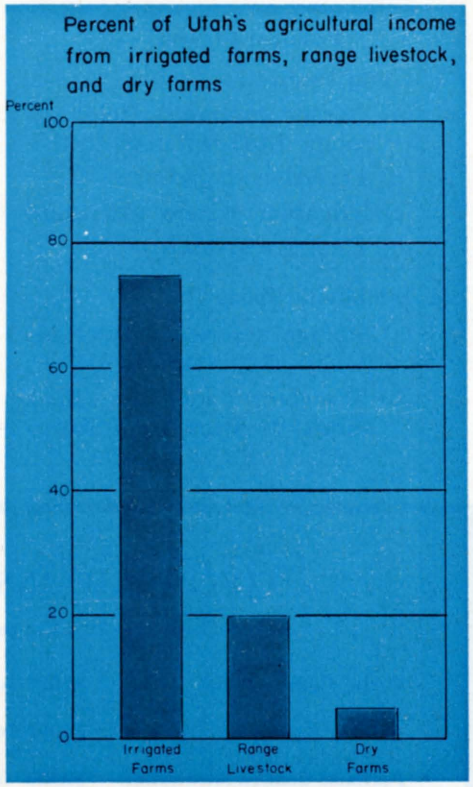


Fig. 1. Of total agricultural income in Utah, 75 percent comes from irrigated farming, 20 percent from range livestock, and 5 percent from dry farming

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Central Utah Project Will Bring Water to Bonneville Basin

THE Central Utah Project is the largest of the contributing projects under the Upper Basin project. Through it Utah will use a major share of her portion of the waters of the Colorado. The Central Utah Project is particularly important because it affords the only practicable means of providing a substantial quantity of new water for the Bonneville Basin. This project is located in the central part of Utah and includes all or part of Uintah, Duchesne, Wasatch, Utah, Salt Lake, Tooele, Millard, and Sevier Counties. It will serve the most thickly populated area as well as the principal agricultural areas of the state.

The initial phase of the project would intercept streams draining the south slope of the Uinta Mountains and would convey the water by gravity flow through the Wasatch Mountains to the Bonneville Basin. The water would be collected by an aqueduct leading to a storage reservoir high in the Wasatch Mountains. From the reservoir, the water would drop through a series of hydro-electric plants before being used in the Bonneville Basin for irrigation, municipal, and industrial purposes. Replacement water and water for new development in the Uinta Basin would be provided by development of storage in local streams.

The material for this article was supplied by the Utah Water and Power Board.

Principal Features

1. Uinta Basin
   - (a) Storage reservoirs (total capacity 1,617,800 acre feet)
   - (b) Diversion dams
   - (c) Irrigation system extensions
   - (d) Drainage systems
2. Bonneville Basin
   - (a) Storage reservoirs (total capacity 86,390 acre feet)
   - (b) Strawberry aqueduct (Rock Creek to Strawberry Reservoir)
   - (c) Strawberry reservoir enlargement (1,370,000 acre feet)
   - (d) Two tunnels to Bonneville Basin
   - (e) Four power plants
   - (f) Aqueducts to Utah and Juab Counties
   - (g) Bates Reservoir
   - (h) Provo Bay dyke and irrigation drainage system
   - (i) Enlargement of Jordan River

The initial phases of this project will provide water for 21,650 acres of new land and 97,350 acres of partially irrigated land. It will provide power for municipal and industrial uses and for irrigation pumping. It will provide flood protection and reclaim Provo Bay, a swamp area near Provo. It will provide water for the rapidly growing iron, steel, metal alloy, chemical, fertilizer, oil and gas industries, and for the many service facilities resulting from such industries.

The Central Utah Project covers the most thickly populated areas of the state, the best agricultural areas, and the source of raw materials basic to new industries. Water and power are the two resources necessary to the continued growth of Utah. This project will provide both.

CONTRIBUTIONS TO RESEARCH

November 15, 1954 to February 15, 1955

Cache County, Utah	**$5000 for drainage studies**
Bakelite Company	**$5000 for canal lining studies**
Portland Cement Association	**$2500 for investigation of the methods and value of building soil-cement irrigation ditches**
Shell Chemical Corporation	**$1000 for studies on insect control**
Libby Owens Glass Co.	**200 glass bricks for windows in experimental poultry houses**
Geigy Agricultural Chemicals	**50 pounds Chel 330 for research on chlorosis**
A. E. Staley Mfg. Co.	**5 gallons of refined soybean oil for insecticide residue studies**